245 an Indian species, now naturalized, but of possible pre-European introduction (Yuncker, 1959: 131; Parham, 1972: 104), plus the following species, most of post European contact introduction: physic nut - fiki (Jatropha curcas), frangipani - kalosipani (Plumeria acuminata and P. rubra) and 'olive (Duranta repens), all native to tropical America (Yuncker, 1959); the perfume tree - mohokoi (Cananga odorata), the pink and white shower tree - kasia (Cassia javanica), cinnamon - sinamoni (Cinnamonum zeylanicium), and the clove - sipaisi (Syzygium aromaticum), all native to tropical Asia (Yuncker, 1959; Kuck and Tongg, 1958; Prevost and Pitkanen, 1970); the flamboyant or poinciana - 'ohai (Delonix regia), native to Malagasy; (Stone, 1970: 313); the African tulip tree - tiulipe (Spathodea campanulata) native to tropical Africa (Parham, 1972; Yuncker, 1959); kasia (Albizia lebbeck), native to tropical Asia and Africa (Yuncker, 1959); kapok - vavae (Ceiba petandra), prehistoric in America, India and Africa (Stone, 1970); sita (Melia azedarach), native to China; and Norfolk Island pine - paini (Araucaria excelsa), native to Norfolk Island.

Finally, there are a small number of comparatively recent introductions, including a number of Australian species:

[318] [654] Australian gums - pulukamu (Ecalyptus spp.) and silky oak - 'oke (Grevillea robusta); and the tropical American, West Indian cedar - sita Palangi (Cedrela odorata), which

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have been distributed by the Department of Agriculture as part of a reforestation scheme.

Common Weeds and Secondary Vegetation Species

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[262]

There are a great number of common weed species found throughout Tongatapu in secondary vegetation associations, many of which are eaten or are used in some beneficial way (see Appendix E)[A] as well as serving as reliable indicators of both soil fertility and the period of time that land has been under fallow. Some of these weedy species are possibly native to Tonga, but a majority of them are post-European contact introductions which have become dominants in most secondary vegetation associations (Merrill, 1945: 119). In some cases, they were deliberate introductions as ornamentals or fodder grasses, such as Lantana camara, Panicum maximum, Rhynchelytrum repens, Melinis minutiflora and Mimosa pudica (Government of Tonga, 1949: 4; Yuncker, 1959: 62). The most common weed species on Tongatapu and the assumed places of origin are listed below:

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[247]

A majority of the common weeds seem to be native to tropical America; these include: te'ekosi (Ageratum conyzoides); tu'ulapepe or vavae kona (Asclepias curassavica); fisi'uli (Bidens pilosa); misimisi (Canna indica); te'epulu or tengafefeka (Cassia tora); hefa (Cenchrus echinatus); piini or piisi (Crotalaria mucronata); lau veveli (Elephantopus mollis); 'akauveli (Indigofera

[A] [See Category 137, pp. 377-431--Analyst.]

231 mares to upgrade the standard of work horses in the Kingdom.
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654 Owing to the rapid elimination of native forest species
654 on Tongatapu, as a result of the need for firewood and
245 timber for banana shooks and other purposes, the Agriculture
318 Department has a limited reforestation program, which
[313] includes nurseries at Sopu on Tongatapu and on 'Eua and the issuance of seedlings to interested allotment holders. The major species which have been planted by individual allotment holders have been Casuarina equisitefolia, Eucalyptus spp., and Grevillea robusta, all natives of Australia, and the tropical American Cedrela odorata. The only major reforestation project in the Kingdom has been conducted on 'Eua, where 200 acres of Pinus caribaea have been successfully established (Government of Tonga, 1971c:26). On Tongatapu, there are only limited cases where farmers have planted introduced forest species on their allotments.

241 In conclusion, the overall effect of the recent
231 introductions of new techniques and plant and animal
179 material on the Tongan agricultural system seems to have been minimal. This is in spite of considerable subsidies
241 offered by government agencies and a recently expanded
231 agricultural extension program, yearly agriculture shows,
654 a system of "Rural Broadcasting" designed to improve agri-
207 cultural education over the radio, the establishment of a
179 Government Agricultural Training Center at the Experimental Farm in Vaini, and a continued overall effort by the Agri-

241 (Syzygium aromaticum), huni (Phaleria disperma), fehi
245 (Bauhinia monandra), and sita (Melia azedarach). Jatropha curcas is commonly planted as a living fence and, on one sample allotment, to support vanilla. The other species are generally planted as borders near dwellings or around
137 small family cemeteries. Phaleria disperma is also found wild in coastal littoral forest, while M. azedarach is sometimes found as an escape.

241 Three tree species that have been introduced by the
245 Department of Agriculture as part of a reforestation pro-
654 gram were also found on some of the sample allotments:
318 silky oak or 'oke (Grevillea robusta) on eight allotments; Australian gum or pulukamu (Eucalyptus spp.) on two allotments; and cigar box cedar or sita Palangi (Cedrela odorata)
241 on one allotment. Extensive stands of G. robusta and C.
245 odorata approximately seven years in age had been planted on one allotment.

241 On the sample bush allotments there seems to be a
137 lower concentration of useful trees in west central Hahake, between Vaini and Fua'amotu and in north central Hahake, southwest of Kolonga, presumably because of the high incidence of plowing and frequent wildfire.

241 Although there is still a considerable diversity of
137 valuable trees found throughout the cultivable area as well
313 as in portions of coastal, swamp, and mangrove forests on Tongatapu bush allotments, the current shortage of timber

241 and firewood, together with the increasing use of the plow,
137 will undoubtedly bring about a further reduction of these
313 species. Trees such as nukonuka (Decaspermum fruticosum),
137 tangato (Pleiogynium solanderi), and hea (Parinarium insularum) which, according to Tongan informants, were common throughout Tongatapu in the past, were not encountered in the sample of the 101 bush allotments. The greatest reduction of the number of valuable tree species was probably due to the rapid expansion of the banana industry in the mid-1960's. The demand for banana cases led to the uncontrolled milling of the timber resources of Tongatapu, where most of the Kingdom's cases were produced until 1967. As early as 1964, the Annual Report of the Minister of Agriculture stated that:

> The situation in Tongatapu with regard to the felling of trees for the saw-mills is critical as the usual source of supplies [natural forests] have almost depleted [sic] and loggers have already started their attacks on useful trees such as mangoes, candlenut, etc. To make things worse the old feta'anu [Excoecaria] trees on the shore have also been used by millers which consequently will weaken the protection of the coasts and the shores against sea erosion (Government of Tonga, 1965: 21).

In 1968, the Agriculture Department reported that:

> ...the supply of logs on Tongatapu has already reached the critical level following the extermination of natural forests and in some cases useful tree crops also. As a result, most of the sawmillers operating around Tongatapu have moved to 'Eua Island where there is a more abundant supply of logs (Government of Tonga, 1969a: 13).

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318 There are also a number of species which have been introduced by the government as part of afforestation schemes; these include: Grevillea robusta, Eucalyptus spp., and Cedrela odorata, which have been planted on some allotments.

241 On bush allotments the fallow or secondary vegetation has a very important role in the cropping succession.

241
137 Approximately two-thirds of the area of bush allotments is under some stage of bush fallow or natural vegetation, ranging in composition from native coastal forests, mangrove swamps, tropical lowland forests, and mature stands of secondary forest, to ephemeral associations of pioneer weed species. About 14 per cent of the sample allotments were completely under various stages of fallow vegetation; in no case was an individual allotment under 100 percent cultivation. There were very few areas under what Boserup (1965:15) classifies as forest fallow: under fallow for

[311] sufficient time for forest to regenerate. Only 9 percent of the uncultivated acreage was over ten years of age, and a majority of this was actually uncultivable coastal or swamp forest. Another 21 per cent had been under fallow for approximately five to ten years, and the remaining 70 percent had been under fallow for less than five years and was characterized by bushes, grasses, ephemeral pioneer species, and few trees.

In those areas which had been under fallow for over five years, the dominants are usually native tree species,